The Impact of Carbon Tax on GDP and Environment

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Abstract

This study aims to look at the impact of imposing carbon taxes as an effort to reduce the effects of greenhouse gases. By using GTAP-E, this study found that the imposition of a vehicle carbon tax of 5 percent resulted in a reduction in the GDP rate of 0.01 percent and effectively reduced the level of carbon dioxide emissions by 0.06 percent.

*Keyword:*Carbon tax, GTAP

1. Introduction

In 2014 Indonesia's total greenhouse gas emissions reached 1.808 million tons of CO2. This figure shows an increase in emissions from 2011 to 2013 of 3.5 percent per year. The biggest contributor to greenhouse gas emissions comes from the forestry sector. Emissions from the forestry sector are caused by forest fires or peatlands. Then, the energy sector ranked second in contributing to greenhouse gas emissions. The energy sector contributes a lot to emissions from fuel combustion in both electricity and heat production, transportation, manufacturing and construction industries, housing, and oil refining activities (BPS, 2017).

The amount of greenhouse gas emissions produced by the energy sector is strongly influenced by energy consumption, especially fossil energy consumption. Energy consumption is dominated by the industrial sector

followed by transportation and households. Carbon dioxide gas is the largest component of greenhouse gas emissions, which amounted to 84.10 percent in 2000 and 81.70 percent in 2012.

Indonesian government through presidential decree no. 23 of 1992 concerning Ratification of the Vienna Convention For The Protection Of The Ozone Layer And The Montreal Protocol On Substances That Deplete The Ozone Layer As Adjusted And Amended By The Second Meeting Of The Parties London, 27 - 29 June 1990 participated in a joint agreement to prevent destruction and ozone depletion. The government seeks to reduce carbon dioxide gas emissions that can damage the ozone layer.

In this regard, the government is reviewing changes in the basis of the determination of taxes from the original cylinder-based emissions to emissions. The lower the emissions produced, the lower the tax paid as well as vice versa the higher the emissions, the higher the tax paid (CNNIndonesia, 2016)

Research conducted by Wesseh & Lin (2018) found that the carbon tax stipulated in China is able to improve welfare with environmental benefits. In addition, through his research, there was a change in the level of environmental degradation between before tax and after tax determination.

A slightly different result is found by Chen & Nie (2016). Imposing carbon tax tends to have an impact on the decrease in the level of social

welfare In the second model, the study initially improved social welfare but subsequently reduced the level of social welfare.

This study seeks to analyze the impact of imposing carbon taxes on carbon dioxide emissions as well as their impact on welfare. The remainder of this paper is organized as follows. The next section discusses the literature review. Then, section 3 discusses the methodology used in this study. Section 4 contains results. Section 5 concludes.

2. Literature Review

This research departs from the government's efforts to reduce emissions levels through changes in vehicle taxation. If the tax is currently imposed on a cylindrical basis, in an effort to reduce the level of carbon dioxide emissions, the tax will be imposed based on the emissions produced.

Research conducted by Zhou, Fang, Li, & Liu (2018) analyzed the imposition of carbon taxes on the transportation sector in China. This study aims to explore the impact of the transportation sector carbon tax on the growth of the transportation sector, macroeconomics and social welfare using the computable general equilibrium (CGE) model. The results of this study are optimal carbon tax is 50 Chinese yuan (RMB) / ton-co2. At this tax rate, energy demand and carbon reduction have less impact on macroeconomic and transportation conditions.

Research conducted by Wesseh & Lin (2018) analyzes how emissions tax policies affect the amount of energy supply, welfare, and environment.

The results of this study are that the carbon tax set in China is able to improve welfare with environmental benefits. In addition, through his research, there was a change in the level of environmental degradation between before tax and after tax determination.

Chen & Nie (2016) analyzed the optimal social welfare model based on the energy department oligopoly competition. According to the model, the article calculates the elasticity of substitution of factors in China's energy sector, non-energy departments and consumption preferences in domestic energy and non-energy commodities. Based on the optimal social welfare model, the effects on social welfare caused by carbon taxes in different relationships are further evaluated. The results show that a certain amount of carbon tax in production relations increases social welfare, while in the relations of consumption and redistribution it decreases social welfare.

Setiawan & Cuppen (2013) analyzed carbon captured and storage which was considered as an option to reduce CO2 emissions. Stakeholder acceptance of CCS should be understood as a complex idea. This means understanding whether or under what conditions stakeholders will be willing to support CCS, requiring consideration of stakeholder perspectives on broader questions about reducing CO2 emissions and energy supply in Indonesia, rather than learning attitudes towards CCS in isolation.

Berry (2019) analyzed the effects of the distribution of carbon taxes in France. Using a microsimulation model built on a representative sample of the

French population starting in 2012, he simulates taxes collected from the energy consumption of each household for housing and transportation. this research shows that carbon taxation provides an opportunity to finance ambitious policies to combat fuel poverty.

3. Method

3.1 The GTAP Model

GTAP is an analytical tool based on the CGE model developed by the Center for Global Trade Analysis, Purdue University with the aim to facilitate economists in conducting international economic research using a broad linkage of economic frameworks between countries. CGE model is a system of equations that model a broad economy because it explains the motivation and behavior of all producers and consumers in the economy and their interrelationships (Burfisher 2011). The structure of the model in GTAP is explained in full by Hertel (1997). The GTAP model assumes that the production function follows the constant return to scale, the market is perfect competition, product differentiation based on country of origin, and full employment.

3.2 Data and Aggregation

This study uses version 9 of the Global Trade Analysis Project (GTAP) database developed by the Center for Global Trade Analysis, Purdue University, which covers 140 countries and 57 sectors (Aguiar, Narayanan,

and McDougall 2016). The regional and sectoral aggregations in this study are as follows:

Tabel 1. Regional Agregation

No.	Country/Region	GTAP-E 9 Database (140 Country)
1.	Indonesia	Indonesia
2.	ROW	All the other economies or regions

Source: author specification base on GTAP-E Database 9

Tabel 2. Sectoral Aggregation

No.	Sectors	GTAP-E 9 Database (57 sectors)
1.	Agriculture	Primary Agric., Forestry and Fishing
2.	Coal	Coal Mining
3.	Oil	Crude Oil
4.	Gas	Natural Gas Extraction
5.	Oil_Pcts	Refined Oil Products
6.	Electricity	Electricity
7.	En_Int_ind	Energy Intensive industries
8.	Oth_ind_ser	Other industries and services

Source: Author specification base on GTAP-E Database 9

Tabel 3. Factoral aggregation

Factor of Production	Aggregation Grup	Factor Mobility
Land	Land	Sluggish (ETRAE = -1)
UnSkLab	Unskilled Labor	Mobile
SkLab	Skilled Labor	Mobile
Capital	Capital	Sluggish (ETRAE = -1)
Natural Resources	Natural Resources	Sluggish (ETRAE = -0,001)

Source: Author specification base on GTAP-E Database 9

3.3 Policy Scenario

This study assumes that the Indonesian government will reduce the level of carbon dioxide emissions from both households and industry. So the scenario in this study is the Indonesian government sets a tax of 5% for each gas consumption.

4. Result and Discussion

The GTAP model predicts a negative effect on Indonesian real GDP as shown in table 4. Based on the scenario, Indonesia's real GDP falls by 0.1 percent and the real GDP of other countries joining Rest of the world rises 0.01 percent.

Table 4. Impact of Real GDP

No.	Country	Change in Real GDP
1.	Indonesia	-0.0011
2.	ROW	0.0001

Source: GTAP model simulation result (2018), processed.

The above results show that the imposition of carbon tax lowers Indonesia's GDP by 0.1 percent. This can happen because people reduce their level of energy consumption which results in lowering the level of GPD. However, the impact of the carbon tax is effective in reducing the level of carbon dioxide emissions as attached to the following table 5:

Table 5. carbo dioxide emission

No.	Country	Change in Real GDP
1.	Indonesia	-0.0006
2.	ROW	-0.0121

Source: GTAP model simulation result (2018), processed.

Imposing a carbon tax of 5 percent has an impact on reducing carbon dioxide emissions by 0.06 percent. The results of this study are in line with the research conducted by Zhou et al. (2018) where the study resulted in a carbon tax capable of reducing the level of carbon dioxide emissions and had little impact on macroeconomic conditions. This result is slightly different

from the research conducted by Wesseh & Lin (2018) were in his research the imposition of carbon taxes increased the welfare of the community.

5. Concluding Remarks

Establishing carbon taxes as an effort to reduce the level of greenhouse gas emissions caused by energy burning has two implications. The first implication is the negative impact of the carbon tax on GDP. The most relevant reason for this impact is because people reduce productivity due to the imposition of carbon taxes. The second implication is that the impact of the carbon tax is effective in reducing the level of carbon emissions.

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